(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 621 578 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **94106025.3**

(51) Int. Cl.5: **G09G 3/36**

(22) Date of filing: **19.04.94**

(30) Priority: **22.04.93 JP 95798/93**
22.04.93 JP 95800/93
28.04.93 JP 102303/93
14.05.93 JP 112861/93
14.05.93 JP 112862/93

(43) Date of publication of application:
26.10.94 Bulletin 94/43

(84) Designated Contracting States:
DE FR GB

(71) Applicant: **MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.**
1006, Oaza Kadoma
Kadoma-shi, Osaka-fu, 571 (JP)

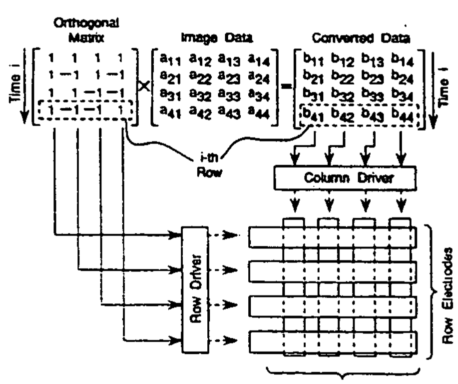
(72) Inventor: **Fukui, Yasuhito**
C18-104, 5-8, Korigaoka
Hirakata-shi, Osaka-fu (JP)
Inventor: **Yumine, Manabu**
Showa-ryou, 16-1, Miyamae-cho
Kadoma-shi, Osaka-fu (JP)
Inventor: **Matsumoto, Tokikazu**
3-13-8, Tanabe,
Higashisumiyoshi-ku
Osaka-shi, Osaka-fu (JP)

(74) Representative: **Eisenführ, Speiser & Partner**
Martinistrasse 24
D-28195 Bremen (DE)

(54) Driving apparatus for liquid crystal display.

(57) A driving apparatus for a liquid crystal display of a type sandwiching a layer of liquid crystal material capable of responding to a voltage of an effective value applied between row and column electrodes. The apparatus includes an image data buffer memory for storing and outputting a digital image data of one frame, transferred from an external circuit, in the form of an image data matrix; a matrix generator for outputting data having a predetermined orthogonal matrix; a converter for converting the image data with the use of the orthogonal matrix into an converted data matrix and for outputting the converted data matrix; a converted data buffer memory for storing and outputting the converted data matrix; a driver for driving the liquid crystal display in synchronism with a row signal, which applies the orthogonal matrix to the row electrodes of the liquid crystal display, and also a column signal which applies the converted data matrix to the column electrodes of the liquid crystal display.

Fig.2



EP 0 621 578 A2

BACKGROUND OF THE INVENTION

(Field of the Invention)

The present invention relates to a driving apparatus for a liquid crystal display utilizing an addressing technique effective to permit a fast responding STN (Super Twisted Nematic) simple matrix type liquid crystal display to provide images of high contrast.

(Description of the Prior Art)

The liquid crystal display is nowadays used as one type of flat panel displays, an exemplary type of which is a STN simple matrix type liquid crystal display. As shown in Fig. 1, this STN simple matrix type liquid crystal display is of a simple structure includes a plurality of transparent, stripe-shaped first electrodes formed on a first glass substrate so as to extend in one direction, a corresponding number of similarly transparent, stripe-shaped second electrodes formed on a second glass plate so as to extend in a transverse direction perpendicular to such one direction to thereby form a matrix of row and column electrodes together with the first electrodes, and a layer of liquid crystal material sealingly sandwiched between the first and second glass substrates. Due to this peculiar structure, the STN liquid crystal display has an advantage in that it is inexpensive to make. With the advent of a STN liquid crystal display having a fast responding characteristic and capable of displaying time-varying image of a video-rate, the field of application of this STN liquid crystal display is now expanding.

However, It has been found that the fast responding STN simple matrix type liquid crystal display is susceptible to a considerable reduction in image contrast if it is driven by the use of the conventional driving technique in which a select voltage is applied at a time to one of the row electrodes during one frame period while information to be applied to pixels aligned with such one of the row electrodes is supplied through the column electrodes. To avoid this considerable reduction in image contrast, a new driving technique has been suggested to improve the image contrast exhibited by the STN simple matrix type liquid crystal display by selecting the plural row electrodes simultaneously at a time and selecting a number of times one of the row electrodes during one frame period.

This recently suggested driving technique is shown in will be discussed with reference to Fig. 2. A voltage proportional to a data having a predetermined orthogonal matrix is applied as a row signal to the row electrodes of the STN simple matrix type liquid crystal display. The orthogonal matrix referred to above consists of a data of two binary digits of "1" and "-1" or a data of three binary digits of "1", "0" and "-1", in which the inner product of arbitrarily chosen two different ones of the row vectors forming parts of the matrix or arbitrarily chosen two different ones of the column vector forming parts of the matrix necessarily be zero. Of the data having this matrix, the binary digits "1", "0" and "-1" are taken as Low, Middle and High levels, respectively, and are used as row signals. In other words, a three-digit driver is used for a row driver.

Also, with respect to a digital image data for each frame to be displayed by the liquid crystal display, a product of the digital image date times the orthogonal matrix to be used for driving the row electrodes is determined and is then converted into a converted data. A voltage proportional to the value of each element of the converted data is applied, as a column signal, to the column electrode of the STN simple matrix type liquid crystal display. If the image data is of a multi-step gradation, the converted date correspondingly represents a multi-level data and, therefore, an analog driver is employed for a column driver. In addition, since the use of this driving technique results in an increase of the column voltage of the column signal, it is inevitably necessary to use the column driver having a high breakdown voltage. Thus, when the two signals are applied to the two sets of the electrodes of the liquid crystal display, an effective voltage proportional to each element of the image data is accumulated in the row and column electrodes during one frame period. Since respective portions of the liquid crystal layer aligned with the pixels permit passage of light therethrough in dependence on the effective voltage between the row and column electrodes, an image can be displayed on the liquid crystal display.

This newly suggested driving technique is described by T.J. Scheffer and B. Clifton in "Active Addressing Method for High-Contrast Video-Rate STN Displays" [1992 SID Digest of Technical Papers XXIII, 228-231 (1992)], by B. Clifton and D. Prince in "Hardware Architectures for Video-Rate, Active Addressed STN Displays" [Proceedings 12th International Display Research Conference, 503-506 (1992)] and by A.R. Corner and T.J. Scheffer in "Pulse-Height Modulation (PHM) Gray Shading Methods for Passive Matrix LCDs." (Proceedings 12th International Display Research Conference, 69-72 (1992)].